Variations of wood property in several Japanese Picea species

Picea species is one of the important plantation species in boreal zone. *P. jezoensis* and *P. glehnii* are important plantation species in Hokkaido, Japan, and are designed as target species on Japanese tree breeding programs. On the other hand, some of *Picea* species in Honshu, Japan, such as *P. koyamae*, has restricted natural range and small population size, resulting in assignment for endangered species. Using *P. koyamae* as plantation species for wood production is one of the methods to avoid extinction of this species. Compared to other plantation *Picea* species, e.g., *P. abies*, however, information about wood properties is still limited for Japanese *Picea* species. Control of variation in wood properties is one of the requirements for wood utilization of plantation species. Thus, it is an important issue to clarify the variations of wood properties. The objectives of this study are 1) to clarify variations in wood properties in three Japanese *Picea* species, *P. jezoensis*, *P. glehnii* and *P. koyamae*, 2) to estimate genetic variation and inheritance in breeding materials of *P. jezoensis* and *P. glehnii*, and 3) to evaluate variations of wood properties and qualities in plantation-grown trees of *P. koyamae*.

In 10 open-pollinated families of *P. jezoensis*, significant differences among families were observed for all wood properties, such as microfibril angle (MFA) of S2 layer in latewood tracheid, wood density and bending properties. Compared to growth characteristics, larger *F*-values were obtained in wood properties, indicating that contribution of genetic effect is also larger in wood properties. Although *F*-values of wood properties decreased with increase in annual ring number, genetic
control of wood properties exists from the pith side to the 25th annual ring from the pith. This result revealed that wood properties at both juvenile and mature woods can be improved by tree breeding programs in P. jezoensis.

In nine open-pollinated families of P. glehnii, significant differences of MFA, wood density, and bending properties were found among nine families from the 6th to 15th annual ring from the pith. In addition, larger values of coefficient of variation in wood properties were also observed from the 6th to 15th annual ring from the pith. These results indicate that contribution of genetic effect is larger at these positions. Moreover, wood property values at the positions showed significantly positive correlations with those in mean values. Therefore, wood properties can be effectively improved through tree breeding programs by evaluating wood from the 6th to 15th annual ring in P. glehnii.

Clonal variations of wood properties were significant in both juvenile and mature woods in six plus-tree clones. On the other hand, repeatability and genetic coefficient of variation in juvenile wood were larger than those in mature wood, indicating juvenile wood improvement is effective for this species. The relationships of variations in wood properties were also clarified between 16 full-sib families and six their parental clones in P. glehnii. Radial variations of basic density and MFA in full-sib families were almost similar to those in parental clones. In addition, significant, positive parent–offspring correlations were found in basic density and MFA. These results indicate that degree of variation in wood properties is heritable from parents to offspring. Therefore, it is considered that crossing of both female and male parents which have desirable wood properties might produce offspring with superior wood properties.

In wood property values obtained from different two stands in P. koyamae, almost the same values of wood properties were found in mature wood, whereas there were differences in wood properties between stands in juvenile wood. Mean values of wood properties and wood quality of 2×4 lumber in plantation-grown trees of P. koyamae were almost similar to those reported in other plantation Picea species. In addition, bending properties of 2×4 lumber in P. koyamae had sufficient wood quality to utilize them as construction materials. Thus, it is expected to utilize P. koyamae as plantation species for wood production, especially for constructions.

Based on the results obtained, variation of wood properties in Japanese Picea species was found to be considerable in juvenile wood. In addition, it was demonstrated that wood properties in juvenile wood were more genetically controlled than those in mature wood. Therefore, it is concluded that improving juvenile wood properties is effective method to obtain trees with desirable wood properties in Japanese Picea species.